Evaluating the Spread of Armillaria in Itasca State Park Old-Growth Forests

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Introduction

Itasca State Park in northern Minnesota is currently at serious risk of increasing levels of fungal infection, due to the warming of the climate as well as stresses posted upon the area by drought conditions of the past few years. The old-growth forests at Itasca State Park and their associated long-term data records provide a unique opportunity to understand how past forest development may impact the current prevalence of Armillaria fungi in these forests. Armillaria is a common root-rot fungus in red pine forests that has historically shaped patterns of mortality and forest structural and compositional development.

The specific plot used to understand and document Armillaria species within this experiment was the Allison plot, a 2-hectare plot originally established in the 1920's by J.H. Allison of the Department of Forest Resources at the University of Minnesota. This plot provided a rich record of over 80 years of forest development, including the mortality of Jack Pine and an increased complexity in the spatial pattern of dead trees[1].

Armillaria has been noted to colonize and persist in dead jack pine and red pine, and has previously been documented as an important agent of mortality for white pine in northern forests of Minnesota and Wisconsin[2].

This research aimed to investigate which Armillaria species are present within the Allison plot, and therefore better understand the potential for this fungi to influence long-term patterns of mortality of red pine in this forest. The spread of Armillaria can be detrimental and deadly to forest health. Although Armillaria was noted in previous surveys of this plot [1], the extent of the fungus through the forest has not been thoroughly documented or studied. The accumulation and documentation of a variety of fungi species in Itasca State Park would have insight into the effect of climate change on species habitat, and may give further understanding as to the future of the forests in this area, including their diversity and survival of species commonly found in the Itasca area.

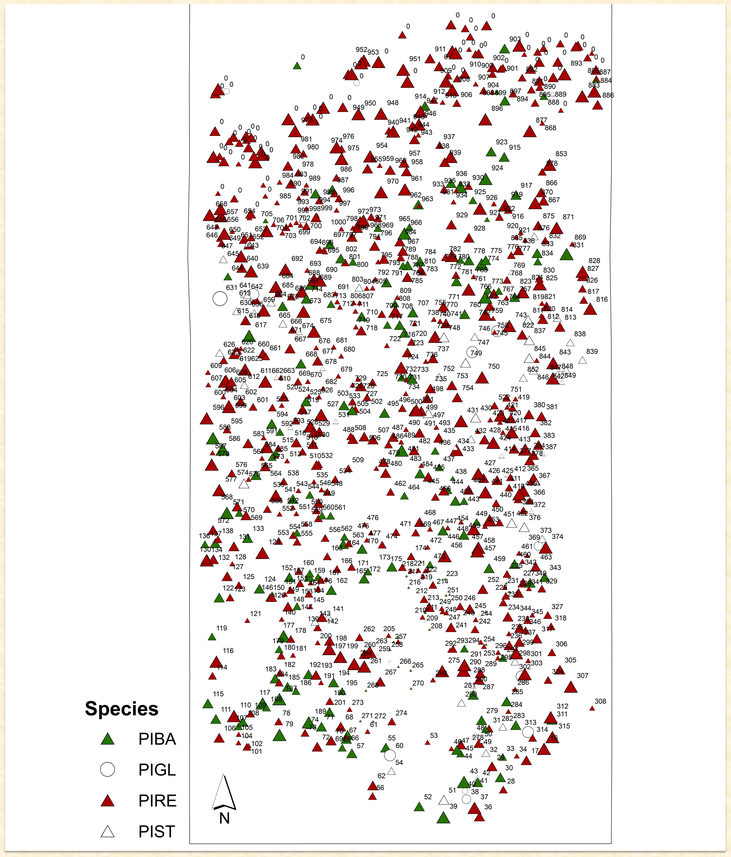

Figure 1: GIS map of the Allison Plot by tree species. The circle in black denotes the area where *Armillaria ostoyae* was found.

Figure 2: Fungi found within the Allison plot; top right shows *Peniophora cinerea*, top left and bottom images show *Armillaria ostoyae*.

Methods

Collections of samples were made across multiple areas of the Allison plot within Itasca State Park. A total of 40 samples were taken from different aspects, soil conditions, tree species occurrences, and from transects originating from dead and declining trees. Samples were kept cool and brought back to the laboratory at the University of Minnesota for analyses. Isolations were made on cultured media using aseptic techniques [1, 3]. Pure cultures were identified using DNA extraction and sequencing, followed by Basic Local Alignment Search Tool (BLAST) to match to similar GenBank sequences. Primers AR1 and AR2 were used for identification.

Results

From the samples taken across the forest, *Armillaria ostoyae* was identified along the outer edge of the Allison plot through cultures and DNA sequencing (figure 1, 2). *A. ostoyae*, also called the honey mushroom, is only visible as a small percentage of its overall growth above ground. As a forest pathogen, *Armillaria* species are responsible for white-rot root disease are able to kill host tree species[3]. Rhizomorphs spread close to the surface of the soil, invading new roots and girdling nearby trees. During sampling, symptoms of *Armillaria* were present in many other plot trees in the form of black bootlace-like strands under the outer bark layer.

Two other species of note were also identified in the Allison plot. These included *Peniophora cinerea* (figure 2; top right image) and *Chaunopycnis pustulata*. Little information is known about either of these species of fungi, though *P. cinerea* has been found in studies done in Chile.

Conclusion

Studies such as this one, with a focus on surveying to better understand what is present, are important for understanding the long-term health of the forest as a whole. Certain fungi can play harmful roles in forest development, such as the spread of *Armillaria* root rot. Further surveys of these plots to document changes in fungal composition over time, and to detect new fungi may point to new threats and change to overall forest health. These results will be useful to foresters hoping to preserve old-growth forests as fungi spread across the northern forests, and will increase our understanding of the role root-rot fungi play in forest dynamics.

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References
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